A NOTE ON THE ANDROECIUM OF THE GENUS CROTON AND FLOWERS IN GENERAL OF THE FAMILY EUPHORBIACEAE

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The occurrence of haplostemony, diplostemony, and triplostemony represents a regular sequence in the Angiosperm flower. The reverse of these arrangements (obhaplostemony, obdiplostemony, and obtriplostemony) brings interruptions in the usual arrangement. Many hypotheses have been proposed in the past to explain these reversal arrangements. The most acceptable one has been the "reduction concept." According to this concept, in all flowers exhibiting obhaplostemony, obdiplostemony, or obtriplostemony, the present outer whorl represents what was once the second whorl of stamens. Thus all obhaplostemony flowers were once diplostemony ones and so on (Eames 1961). This reduction concept derives support from the presence of some rudiments of staminal structures in a few flowers of this kind. People who resent the concept of reduction believe that the staminal arrangement in the Angiosperm flower is only a matter of spatial and mechanical possibilities and that it has nothing to do with the morphological modifications in the flower.

A study of the flowers of Euphorbiaceae in general and of _Croton_ L. in particular adds some insight into this problem. The flowers of Euphorbiaceae are usually unisexual, but bisexual flowers (said to be atavistic) have been reported in _Cicca_ L. (Rao 1973). The flowers of Euphorbiaceae are often apetalous or even achlamydeous (_Euphorbia_ L., _Anthostema_ Juss., and _Synandenium_ Boiss.). Generally the number of staminate flowers, when compared to the number of pistillate ones, is numerous. This strongly suggests that anemophily was once prevalent in this family. Even today, _Mercurialis_ L. is pollinated by the wind. Certain features suggest that this family is returning to the entomophily type of pollination. These include the aggregation of achlamydeous flowers in the form of cyathia bearing one to five extra floral nectaries on the involucre cup, the presence of brightly colored bracts or leaves subtending the flowers, and the presence of nectariferous glands in both male and female flowers. Although the grasses are wind pollinated and are most successful, they have intercalary growth and rhizomes both of which are absent from the euphorbs. Thus it would seem to be a selective advantage to the spurge family to return to entomophily. In most of its members, there has been a total loss of genes for the development of a conspicuous corolla and even those few taxa with corollas have small inconspicuous ones (Jatropa L., with its bright corolla, is an exception.). The absence of the corolla is balanced in various taxa with conspicuous sepals, bracts, or stamens. It is also noteworthy that the number and nature of stamens are very variable in the Euphorbiaceae (eg., 1 in Euphorbia L., 3 and synandrous in Phyllanthus L., 8 to 10 in 2 whorls but all monadelphus in Jatropa L., many and dendroid in Ricinus L., etc.). However, in contrast, the number of ovaries is usually one with three fused carpels.

Croton L. generally has dichlamydeous and heterochlamydeous male flowers and the corolla is inconspicuous. The stamens range in number from 4 to 16 or even more. There are four or five antesepalous nectariferous glands or scales between the corolla and the androecium. The female flowers are generally apetalous and have the staminal scales or glands but no well developed staminodes.

The authors made a study of the staminal arrangement in six species of Croton. Croton monanthogynus Michx. has six stamens per flower. Each flower has one stamen in the center and the five remaining ones are in an antepetalous whorl (obhaplostemony). C. argyranthemus Michx., C. capitatus Michx., and C. glandulosus L. have eleven stamens per flower. Each flower has one stamen in the center and the remaining ten occur in two whorls of five each. The outer whorl is antesepalous (obdiplostemony). C. bonplandianus Baill. and C. punctatus Jacq. have sixteen stamens per flower. Each flower has one stamen in the center and the remaining fifteen stamens occur in three whorls of five each. The outer whorl is antesepalous (obtriplostemony).

In all the above taxa the staminal primordia can proliferate and lead to one or two more stamens per flower or the primordia can fail to develop and lead to one to four fewer stamens per flower. When there is an increase in stamen number, there are two stamens in the center rather than one. Often, all the stamens are attached to a rudimentary stalk in the center of the flower. The central stamen(s) may be functional or sterile. Obviously, the meristem that is generally consumed in the formation of a sterile or fertile gynoecium in other unisexual or bisexual flowers terminates here in a fertile or sterile stamen. This sort of development, coupled with the absence of staminodes in female flowers (scales or nectaries excluded), indicates the strong unisexuality attained by Croton L., and perhaps by the whole family. The occurrence of all three types of unusual staminal arrangements in a single genus is extraordinary. (Its pollen is also characteristic and is called *Croton* type: spherical, bearing minute projections, and without any aperature) (Punt 1962). Perhaps this situation is comparable to the one existing in *Mitella* L. (Saxifragaceae) in which three different staminal arrangements occur: haplostemony (*M. breweri* L.), obhaplostemony (*M. pentandra* Hook.), and diplostemony (*M. nuda* L.)(Cronquist 1968). This reversal staminal arrangement is also seen in *Manihot* Mill. and *Tragia* L., and it is quite possible that other taxa in Euphorbiaceae also exhibit this arrangement; if so, it would strengthen the concept of associating the Euphorbiaceae with the Geraniales.

We conclude that the occurrence of the unusual staminal arrangement in the Angiosperm flower is well explained by the "reduction concept." This conclusion is based on the presence of antesepalous nectaries or scales (all staminal in origin) found between the corolla and the androecium.

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